

2 loading a substrate into a reaction chamber;
3 uniformly terminating dangling bonds on the surface of the substrate with a
4 specific atom;
5 chemically adsorbing a first reactant onto the terminated substrate by injecting the
6 first reactant into the reaction chamber;
7 removing any of the first reactant physically adsorbed into the terminated
8 substrate; and
9 forming a solid thin film by chemical exchange or reaction of the chemically
10 adsorbed first reactant and a second reactant by injecting the second reactant into the
11 reaction chamber,
wherein the specific atom is a component of the solid film.

REMARKS

In the Office Action dated October 2, 2000, the Examiner required that Fig. 8 be designated by a legend such as "Prior Art" and objected to the drawings under 37 C.F.R. § 1.84(p)(5). The Examiner also objected to the disclosure because of an informality. The Examiner rejected claims 1, 3-9, and 11 under 35 U.S.C. § 102(e) as being allegedly anticipated by Comizzoli et al. (United States Patent No. 5,851,849), and rejected claims 1, 3, 6, 7, 9, and 11 under 35 U.S.C. § 102(b) as being allegedly anticipated by Kim et al. (Appl. Phys. Lett., 71, pp. 3604-3606, 22 December 1997). The Examiner rejected

claims 1-9 and 11 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Comizzoli et al. in view of Kim et al.

Drawings

The Examiner has required that Fig. 8 be designated by a legend such as “Prior Art” and objected to the drawings under 37 C.F.R. § 1.84(p)(5).

Regarding Fig. 8, Applicants have added the label “Prior Art” by a Proposed Drawing Correction filed with this response.

Regarding the objection to the drawings under 37 C.F.R. § 1.84(p)(5), the Examiner noted that the reference sign “7” was not mentioned in the specification.

In response to this objection, Applicants have amended the specification at page 11, line 1, to note that the pressure in the reaction chamber 30 is maintained by the pump 7. This brings the specification into conformance with what is shown in the drawings. Furthermore, one skilled in the art would have understood that this was the function performed by the pump 7 shown in Fig. 5. As a result, no new matter has been added by these changes.

Applicants respectfully request that the Examiner consider these amendments to the drawings and specification and withdraw his objection to the drawings under 37 C.F.R. § 1.84(p)(5).

Specification

The Examiner has objected to the disclosure because of an informality. In particular, the Examiner required that the portion under the Brief Description of the Drawings referring to Figs. 1 through 4 should list all of the figures separately.

By this response Applicants have amended the Brief Description of the Drawings to refer to Figs. 1, 2, 3, and 4, as requested by the Examiner.

Applicants therefore respectfully submit that the noted informality has been corrected, and request that the Examiner withdraw the objection to the specification.

Rejection under 35 U.S.C. § 102(e) based on Comizzoli et al.

The Examiner has rejected claims 1, 3-9, and 11 under 35 U.S.C. § 102(e) as being allegedly anticipated by Comizzoli et al. Applicants respectfully traverse this rejection.

Claim 1 specifically recites “uniformly terminating dangling bonds on the surface of the substrate with a specific atom,” and “forming a solid thin film by chemical exchange or reaction of the chemically adsorbed first reactant and a second reactant.” By this response, and in an effort to better recite the invention, Applicants have amended claim 1 to recite that the specific atom is a component of the solid thin film.

Applicants show this in their disclosed embodiment. Oxygen atoms are used to terminate the dangling bonds on the surface of the silicon substrate (See Applicants’ Fig. 2). These atoms then react with the aluminum present in the TMA (See Applicants’ Fig. 3) and the oxygen in the H₂O to form a thin film of Al₂O₃ (See Applicants’ Fig. 4).

Oxygen atoms are used because they clearly would not be impurities with respect to the thin film of Al_2O_3 . In contrast, nitrogen would clearly not be acceptable as atoms to terminate the dangling bonds in this disclosed embodiment because nitrogen would be a contaminant to the Al_2O_3 film.

The same would be true for any of the thin films of TiO_2 , Ta_2O_5 , ZrO_2 , HfO_2 , Nb_2O_5 , CeO_2 , Y_2O_3 , SiO_2 , In_2O_3 , RuO_2 , IrO_2 , SrTiO_3 , PbTiO_3 , SrRuO_3 , CaRuO_3 , $(\text{Ba},\text{Sr})\text{TiO}_3$, $\text{Pb}(\text{Zr},\text{Ti})\text{O}_3$, $(\text{Pb},\text{La})(\text{Zr},\text{Ti})\text{O}_3$, $(\text{Sr},\text{Ca})\text{RuO}_3$, In_2O_3 doped with Sn, In_2O_3 doped with Fe, and In_2O_3 doped with Zr. Each of these would clearly need to use oxygen atoms to terminate the dangling bonds of the silicon substrate, since only oxygen would not be an impurity.

Similarly, nitrogen would clearly be used terminate the dangling bonds of the silicon substrate in an embodiment using any of the thin films of SiN , NbN , ZrN , TaN , Y_3N_5 , AlN , GaN , WN , BN , WBN , WSiN , TiSiN , TaSiN , AlSiN , and AlTiN . The nitrogen could react with the proper first and second reactants without contaminating the resulting film. In these embodiments oxygen would be unacceptable, since it would be an impurity to any of the nitride films formed.

In contrast, Comizzoli et al. discloses that nitrogen be used as a purge gas and that Al_2O_3 be formed. As a result, any nitrogen forming on the surface of the laser assembly would be viewed as impurities when the deposited aluminum was converted to Al_2O_3 .

Comizzoli et al. therefore does not disclose that the specific atom is a component of the solid film, as recited in amended claim 1.

Claims 3-9 and 11 variously depend from claim 1 and are allowable for at least the reasons given above for claim 1.

Thus, Comizzoli et al. does not disclose every feature recited in claims 1, 3-9, and 11. Applicants therefore respectfully request that the Examiner withdraw the rejection of claims 1, 3-9, and 11 under 35 U.S.C. § 102(a) as being allegedly anticipated by Comizzoli et al.

Rejection under 35 U.S.C. § 102(e) based on Kim et al.

The Examiner has rejected claims 1, 3, 6, 7, 9, and 11 under 35 U.S.C. § 102(b) as being allegedly anticipated by Kim et al. Applicants respectfully traverse this rejection.

As noted above, in order to better recite this invention, Applicants have amended claim 1 to recite that the specific atom is a component of the solid thin film. This feature is not disclosed or suggested by Kim et al.

In particular, Kim et al. discloses that the surface of a silicon wafer is terminated with atomic hydrogen. However, Al_2O_3 is then deposited on the substrate. The hydrogen atoms would be an impurity for the Al_2O_3 , and so would reduce the effectiveness of the resulting device.

Kim et al. therefore does not disclose that the specific atom is a component of the solid film, as recited in amended claim 1.

Claims 3, 6, 7, 9, and 11 variously depend from claim 1 and are allowable for at least the reasons given above for claim 1.

Thus, Kim et al. does not disclose every feature recited in claims 1, 3, 6, 7, 9, and 11. Applicants therefore respectfully request that the Examiner withdraw the rejection of claims 1, 3, 6, 7, 9, and 11 under 35 U.S.C. § 102(b) as being allegedly anticipated by Kim et al.

Rejection under 35 U.S.C. § 103(a) based on Comizzoli et al. and Kim et al.

The Examiner has rejected claims 1-9 and 11 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Comizzoli et al. in view of Kim et al. Applicants respectfully traverse this rejection.

For the reasons above, Comizzoli et al. and Kim et al. do not anticipate claims 1-9 and 11. Neither document cures the deficiencies of the other. Specifically, neither discloses that the specific atom is a component of the solid film, as recited in amended claim 1.

Thus, neither Comizzoli et al. nor Kim et al., alone or in combination, disclose or suggest every feature recited in claims 1-9 and 11. Applicants therefore respectfully request that the Examiner withdraw the rejection of claims 1-9 and 11 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Comizzoli et al. in view of Kim et al.

Conclusion

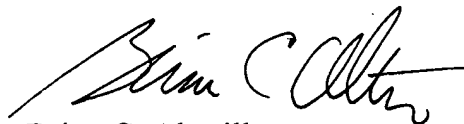
Based on the above amendments and remarks, Applicants respectfully request that the Examiner consider this amendment, enter the listed claim amendments, reconsider

and reexamine this application, and issue a Notice of Allowance allowing pending claims 1-9 and 11.

In the event that there are any outstanding matters remaining in the present application, the Examiner is invited to contact Brian C. Altmiller (Reg. No. 37,271) at (703) 715-0870 to discuss these matters.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge payment or credit any overpayment to Deposit Account No. 50-0238 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17, particularly extension of time fees.

Respectfully Submitted,
Jones Volentine, L.L.C



Brian C. Altmiller
Reg. No. 37,271

Date: December 29, 2000

Jones Volentine, L.L.C.
12200 Sunrise Valley Drive, Suite 150
Reston, Virginia 20191
(703) 715-0870